

Certification, Selection, Care, and Maintenance of Structural Fire Fighting PPE

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NIOSH PPT Program Stakeholders Meeting
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Presentation Topics

- **NFPA Protective Clothing Standards**
- **NFPA 1971, Standard on Protective Ensembles for Structural and Proximity Fire Fighting**
 - History, current requirements, certification, and proposed changes
- **NFPA 1851, Standard on Selection, Care and Maintenance of Protective Ensembles for Structural and Proximity Fire Fighting**
 - Selecting, inspecting, cleaning, repairing, and retiring gear

NFPA Standards Overview

- **Voluntary standards**
- **Created by technical committees**
 - Balanced membership
 - Consensus process
 - Opportunities for public review and input
- **PPE standards address product design, performance, testing, certification, and labeling**
- **Approximate 2 year process for completion**
- **Reviewed and revised on a 5 year cycle**



Input to Standards

- **Public Proposals**

- Submitted at start of process for creating new standard or revising existing standard

- **Public Comments**

- Suggested changes to draft standards

- **Formal Interpretations (FI)**

- Clarifications to existing standards

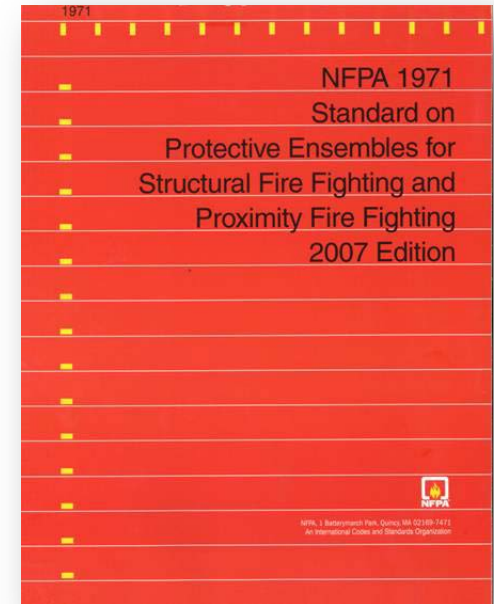
- **Tentative Interim Amendments (TIA)**

- Process for affecting standards on interim basis

NFPA Fire Service PPE Standards

• Existing Product Standards

- NFPA 1951, Technical Rescue PPE
- NFPA 1952, Surface Water Operations PPE
- NFPA 1971, Structural/Proximity PPE
- NFPA 1975, Station/Work Uniforms
- NFPA 1977, Wildland PPE
- NFPA 1981, Open-Circuit SCBA
- NFPA 1982, PASS
- NFPA 1983, Life Safety Rope and Equipment
- NFPA 1984, Respirators for Wildland
- NFPA 1991, Vapor-Protective Ensembles
- NFPA 1992, Liquid Splash-Protective Ensembles
- NFPA 1994, CBRN Incident Protective Ensembles
- NFPA 1999, Emergency Medical Services PPE



NFPA 1971 – Origin and History

- **1975** – First established with assistance from the National Bureau of Standards
- **1981** – Editorial rewrite
- **1986** – Focused on performance requirements
- **1991** – Added third party certification and labeling
- **1997** – Separate standards for garments, helmets, gloves, and footwear were combined into 1971
- **2000** – Total Heat Loss (THL), Conductive and Compressive Heat Resistance (CCHR), Glove Dexterity tests were added and moisture barrier durability conditioning was included

NFPA 1971 – Origin and History

- **2007** – CURRENT EDITION – Combined structural and proximity (NFPA 1976), added optional requirements for CBRN ensembles, mandated Drag Rescue Devices (DRD) and increased design flexibility
- **2012** – PROPOSED EDITION – Addition of stored thermal energy test, full glove burn test, refinement of helmet, footwear, and glove test methods (e.g. definition of terminology, revision of dexterity requirements)



NFPA 1971 Sections

- Chapter 1 – Administration
- Chapter 2 – Referenced Publications
- Chapter 3 – Definitions
- Chapter 4 – Certification
- Chapter 5 – Labeling and Information
- Chapter 6 – Design Requirements
- Chapter 7 – Performance Requirements
- Chapter 8 – Test Methods
- Annex and Index

NFPA Certification Definition

A system whereby a certification organization determines that a manufacturer has demonstrated the ability to produce a product that complies with the requirements of this standard, authorizes the manufacturer to use a label on listed products that comply with the requirements of this standard, and establishes a follow-up program conducted by the certification organization as a check on the manufacturer to determine compliance with the requirements of this standard.

NFPA 1971 Certification

- **To comply with NFPA standards, protective clothing and equipment must be third party certified**
 - Design, label, user guide review
 - Performance testing for initial certification
 - Quality program (ISO 9001) for manufacturers
 - Annual recertification testing and audits
 - Provision for recalls and safety alerts
- **Certified products are listed and labeled by the third party organization**



How Do I Tell if a Product is Listed?

www.ul.com

or

www.seinet.org

Sample Certification Mark



**THIS STRUCTURAL FIRE FIGHTING PROTECTIVE GARMENT
MEETS THE GARMENT REQUIREMENTS OF NFPA 1971, 2007
EDITION. DO NOT REMOVE THIS LABEL.**

**PROTECTIVE GARMENT FOR STRUCTURAL FIRE FIGHTING
IN ACCORDANCE WITH THE
NATIONAL FIRE PROTECTION ASSOCIATION STANDARD ON
PROTECTIVE ENSEMBLES FOR STRUCTURAL FIRE FIGHTING
AND PROXIMITY FIRE FIGHTING
NFPA 1971-2007
*Control No.***

What is a Certification Mark?

Is the manufacturer's declaration that samples of the complete product have been evaluated to a specific product standard, and the products they produce are identical to those tested.

No Certification Mark?

If your PPE is not third party certified, it is not NFPA compliant.

NFPA 1971 Labeling

Requirements of NFPA Certified Product Label

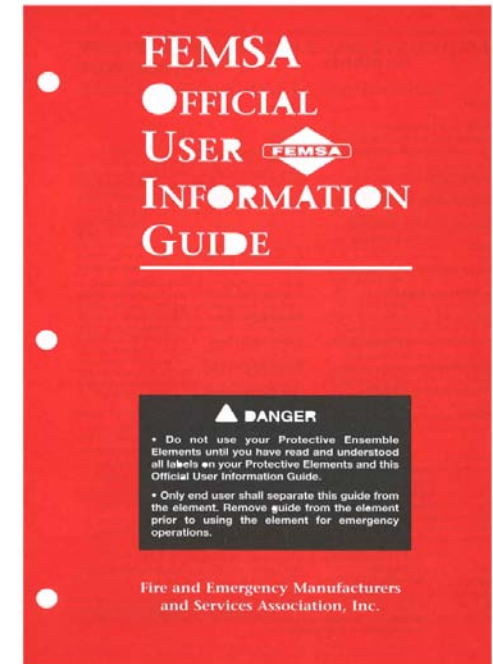
- Certification organization's mark
- Standard to which certified
- Manufacturer's contact information
- Product model or designation
- Date of manufacture
- Principal material of construction
- Other items specific to standard
- Optional CBRN label
- Interface concerns
- Detachable components



NFPA 1971 User Guide

Minimum Required Components

- Safety considerations / limitations of use
- Warranty information
- Storage practices
- Sizing / adjustment
- Donning and doffing procedures
- Interface issues
- Proper use consistent with NFPA 1500 (FD OSH)
- Maintenance and cleaning
- Retirement and disposal information



Design Requirements - Structural Coats

- **Minimum coverage area of garments – upper torso, neck, arms and wrists**
- **Minimum area of garment with moisture and thermal barrier protection**
- **Closure system – positive fasteners with moisture and thermal protection**
- **Sizing requirements – men's and women's**
- **Hardware requirements**



Design Requirements - Structural Coats

- No aramid hook and loop fasteners
- Wristlet or interface component required
- Pockets –drain holes and fasteners to close
- Minimum trim configurations
- DRD must be installed
- Coveralls and attached hoods are allowed

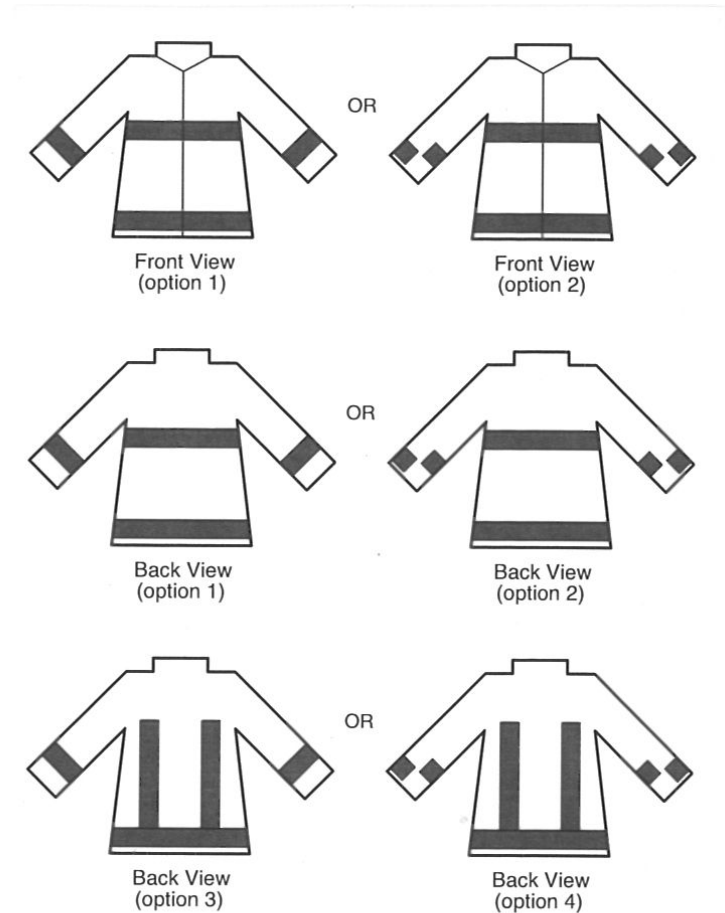


FIGURE 6.2.3 Minimum Required Structural Fire Fighting Coat Trim Patterns.

Design Requirements – Structural Trousers

- Minimum coverage area of garments – lower torso, legs
- Minimum area of garment with moisture and thermal barrier protection
- Closure system – positive fasteners with moisture and thermal protection
- Sizing requirements – men's and women's
- Hardware requirements
- No aramid hook and loop fasteners
- Minimum trim configurations
- Attached booties are allowed



Front/Back View

FIGURE 6.2.4 Minimum Required Structural Fire Fighting Trousers Trim Patterns.

Design Requirements – Structural Helmets

- No openings except by manufacturer for mounting
- Chin strap and nape device required
- Vision requirement for deployed faceshield or goggles
- All helmets must have:
 - Shell
 - Energy absorbing system
 - Fluorescent and retroreflective trim
 - Ear covers
 - Faceshield or goggles or both



Design Requirements – Structural Gloves

- Minimum coverage area past wrist crease
- Consists of composite – single or multiple layers
- Supplemental gloves are not allowed
- Wristlet, gauntlet or interface device required
- Detailed sizing requirements

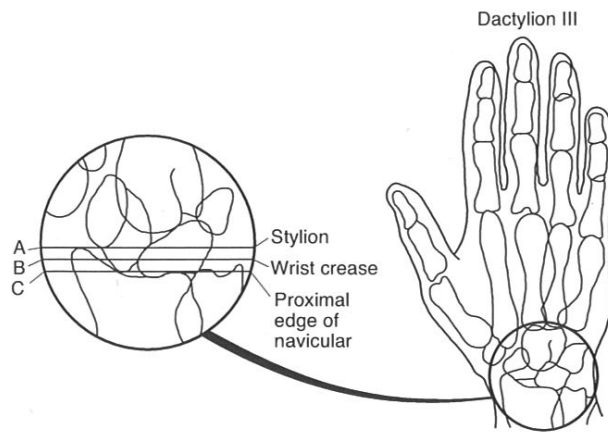


FIGURE 6.7.3.3 Anatomical Landmarks at Base of Hand.

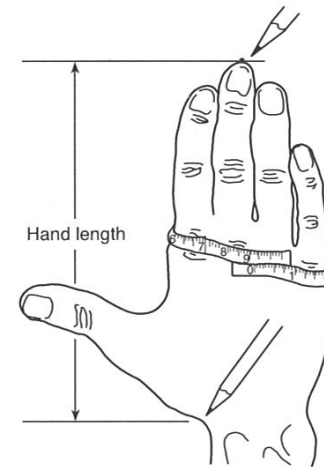
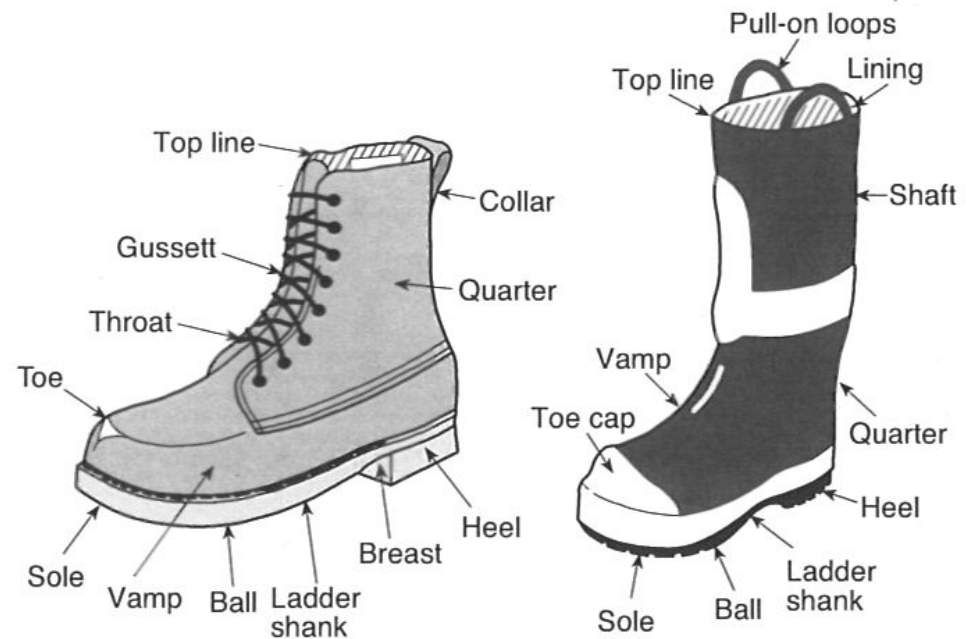


FIGURE 6.7.5 Method of Measuring Hand Dimensions for Selection of Proper Glove.

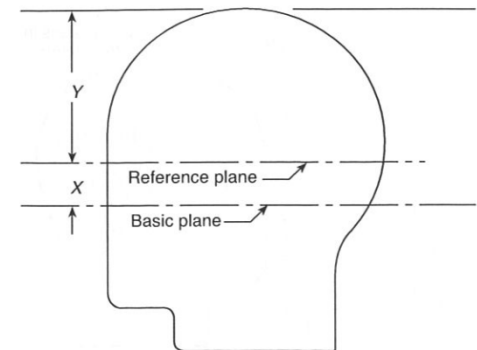
Design Requirements - Structural Footwear

- Minimum coverage area and dimensions
- Sizing requirements – men's and women's
- Hardware requirements
- All footwear must have:
 - Sole with a heel
 - Upper with a lining
 - Puncture resistant device
 - Insole
 - Ladder shank
 - Impact- and compression-resistant toecap



Design Requirements - Structural Hoods

- Minimum coverage area – head, face, neck using ISO J head form
- Can be integrated into coat
- Not required to have moisture barrier protection
- Can be designed to interface with a specific SCBA mask
- Can be designed with a face opening that is manually adjusted



Headform	Size (mm)	X (mm)	Y (mm)
A	500	24	90
B	540	26	96
J	570	27.5	102.5
M	600	29	107
O	620	30	110

FIGURE 8.16.4.1 Location of Reference Plane.

Structural Performance Requirements

- **NFPA 1971 contains 72 test methods**
- **Structural requirements:**
 - Garments and materials – 26 tests
 - Helmets – 22 tests
 - Gloves – 21 tests
 - Footwear – 20 tests
 - Hoods – 10 tests
 - Wristlets – 8 tests
- **Performance requirements exist for components (fabric, thread, hardware), elements (garments, helmets, footwear) and ensembles**

Structural Preconditioning Methods

Certain tests are conducted as received and/or after one or more of the following conditionings:

- Washing and drying
- Room temperature
- Cold temperature
- Convective heat
- Wet conditioning
- Flexing
- Radiant and convective heat



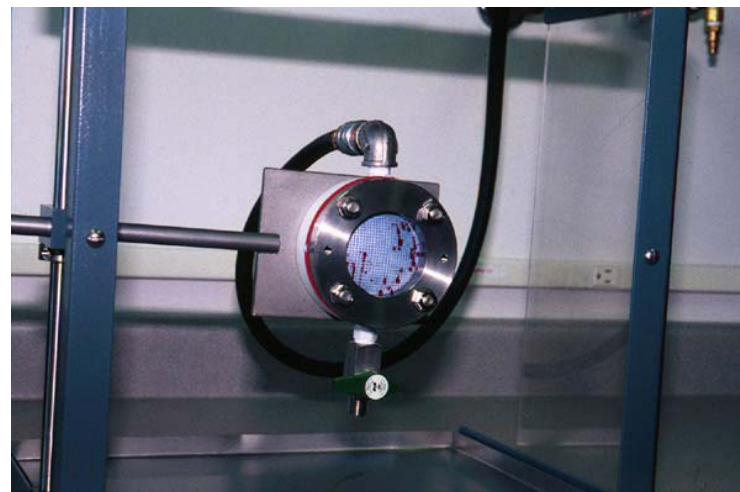
Structural Material Tests

- Flammability Resistance
- Heat and Thermal Shrinkage Resistance
- Conductive and Compressive Heat Resistance (CCHR)
- Tear Resistance
- Cleaning Shrinkage
- Water Absorption
- Label Durability
- Corrosion Resistance



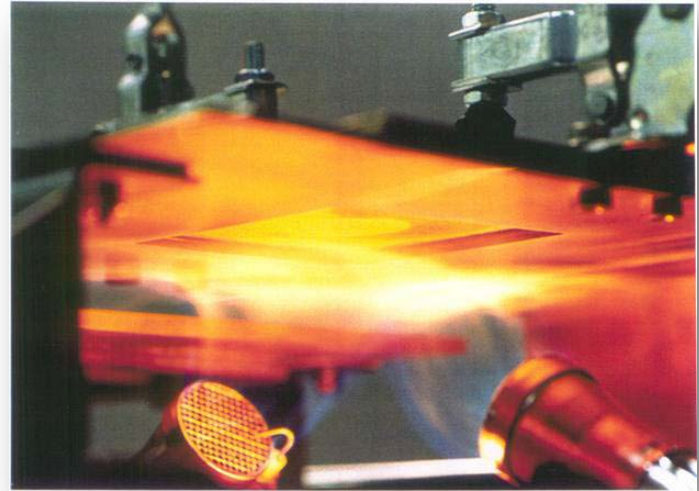
Structural Moisture Barrier Tests

- **Water Penetration Resistance**
- **Liquid Penetration Resistance**
 - AFFF, Battery Acid, Hydraulic Fluid, Fuel C, Chlorine Solution
- **Viral Penetration Resistance**
 - Phi-X-174 Bacteriophage
- **Light Degradation Resistance**



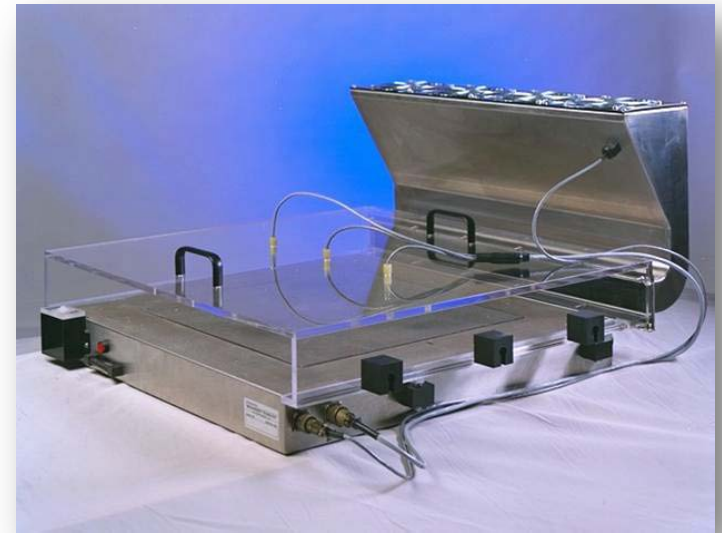
Thermal Protective Performance (TPP)

- Conducted on base composite (outershell, moisture barrier and thermal barrier)
- Measures the thermal protection / insulation
 - $TPP > 35 \text{ cal/cm}^2$
- Burners and quartz lamps
- Higher TPP indicates more thermal protection

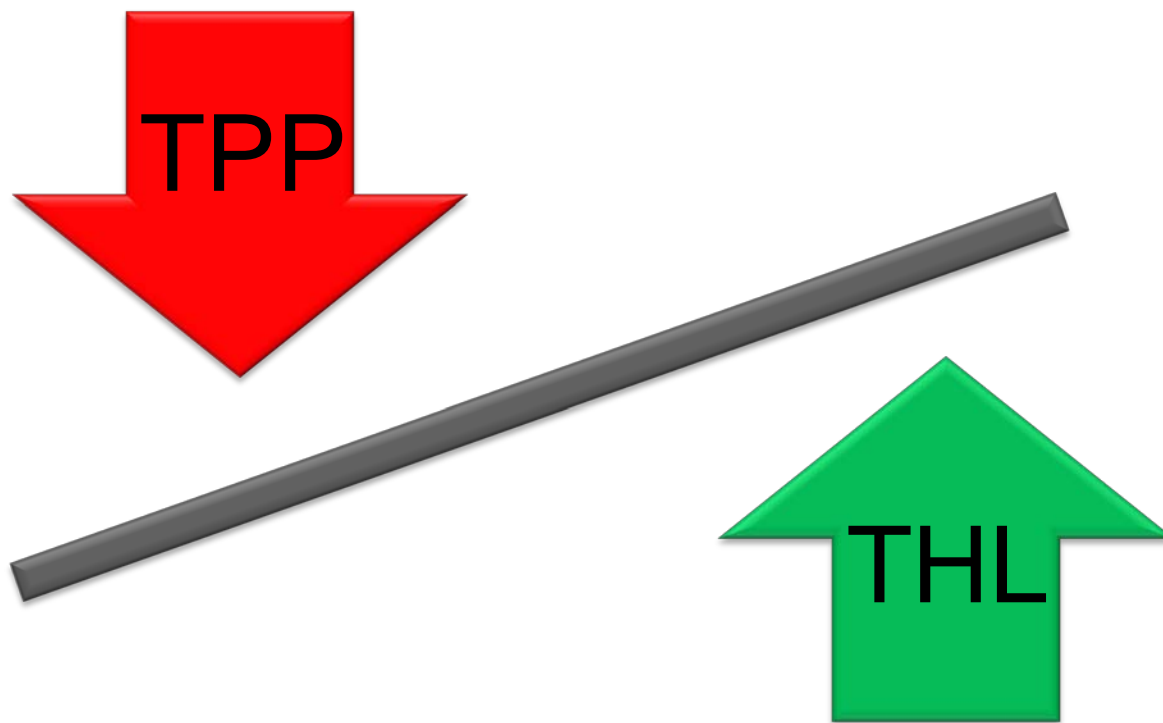


Total Heat Loss (THL)

- Conducted on base composite (outershell, moisture barrier and thermal barrier)
- Measures the evaporative heat transfer
 - $THL > 205 \text{ W/m}^2$
- Performed in dry and wet configurations
- Higher THL value indicates more “breathability” of the composite



Tradeoffs in Insulation vs. Breathability



Structural Garment Tests

- Whole Garment Liquid Penetration Test
- Seam Strength
- DRD Function Test



Structural Helmet Tests

- Top Impact Resistance
- Impact Resistance (Acceleration)
- Physical Penetration Resistance
- Flame Resistance
- Heat Resistance
- Electrical Insulation
- Facepiece / Goggle Tests
- Ear Cover Tests



Structural Glove Tests

- **TPP**
- **Heat and Thermal Shrinkage**
- **Cut Resistance**
- **Puncture Resistance**
- **Glove Hand Function**
- **Grip Test**
- **Glove Donning**
- **Liner Retention**
- **Overall Liquid Integrity and Moisture Barrier Tests**



Structural Footwear Tests

- **Conductive and Radiant Heat Resistance**
- **Flame Resistance**
- **Heat Resistance**
- **Puncture Resistance (Upper and Sole)**
- **Cut Resistance**
- **Slip Resistance**
- **Electrical Insulation**
- **Ladder Shank Bend Resistance**
- **Impact and Compression Resistance (Toe)**



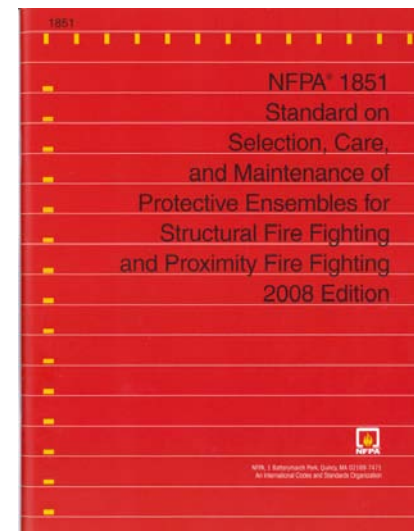
Types of NFPA PPE Standards

- **Product Standards**

- NPFA 1971, 1981 (SCBA)
- Used by manufacturers primarily to certify gear

- **Selection, Care and Maintenance (SCAM) Standards**

- NFPA 1851, Standard on Selection, Care and Maintenance of Protective Ensembles for Structural and Proximity Fire Fighting, 2008 Ed
- Intended for use by the fire service / cleaning and repair facilities
- Does not include use of PPE



NFPA SCAM Standards

- **Existing and proposed Selection, Care, and Maintenance Standards**
 - NFPA 1851, Structural and Proximity PPE SCAM
 - NFPA 1852, SCBA SCAM
 - NFPA 1853, HazMat PPE SCAM*
 - NFPA 1854, Wildland PPE SCAM*
 - NFPA 1855, Technical Rescue PPE SCAM*

*Proposed standards

NFPA 1851 Sections

- **Chapter 1 – Administration**
- **Chapter 2 – Referenced Publications**
- **Chapter 3 – Definitions**
- **Chapter 4 – Program**
- **Chapter 5 – Selection**
- **Chapter 6 – Inspection**
- **Chapter 7 – Cleaning and Decontamination**
- **Chapter 8 – Repair**

NFPA 1851 Sections (Cont'd)

- **Chapter 9 – Storage**
- **Chapter 10 – Retirement, Disposition, and Special Incident Procedure**
- **Chapter 11 – Verification**
- **Chapter 12 – Test Procedures**
- **Annexes and Index**

NFPA 1851 SCAM Program

- **Created by the organization**
- **Written standard operating procedures (SOP)**
 - Records, selection, inspection, cleaning and decon, repair storage, retirement and minimizing contamination
 - Define roles and responsibilities
- **Determine an independent service provider (ISP)**
- **Develop a procedure for accessories**
- **Report any PPE health and safety issues to the certification organizations and manufacturer**

NFPA 1851 SCAM Program - Records

- Person to whom element is issued
- Date and condition when issued
- Manufacturer and model name and design
- Manufacturer's identification number, lot number, or serial number
- Month and year of manufacture
- Dates and findings of advanced inspections
- Dates and findings of advanced cleaning or decontamination
- Reason for advanced cleaning or decon and who completed
- Date of repairs, who performed, and description
- Date of retirement
- Date and method of disposal

NFPA 1851 Selection

- **Complete a risk assessment**
 - Types of duties performed / incidents
 - Number of calls / organization's experiences
 - Geographic location and climate
- **Review NFPA 1971, NFPA 1500, and other regulations**
- **Compare strengths and weaknesses of different gear**
- **Consider interface issues with existing gear**
- **Consider a field evaluation**
- **Develop a detailed purchase specification**
- **Gather bids for certified PPE**

NFPA 1851 Inspection

- **Routine Inspection**

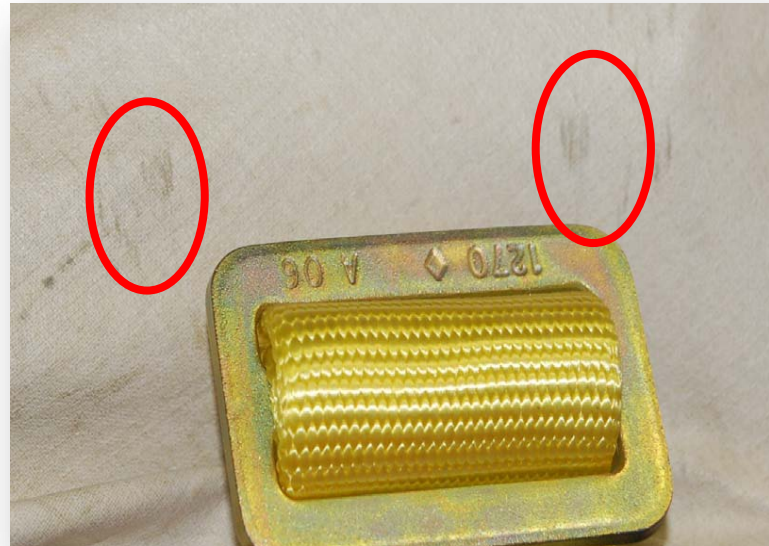
- Completed by the wearer after each use
- Soiling, contamination, thermal or physical damage



NFPA 1851 Inspection

- **Advanced Inspection**

- Completed by verified independent service provider (ISP) or the organization's trained personnel
- Minimum of every 12 months or if routine inspection indicates a more in depth evaluation is needed



NFPA 1851 Inspection

- **Advanced Inspection - Required Tests**

- Light Evaluation of Liners
- Leakage Evaluation (“Bucket Test”)



NFPA 1851 Inspection

- **Complete Liner Inspection**

- Completed by verified ISP or the organization's trained personnel
- Three years after manufacture, then annually
- Each side of every layer is evaluated



NFPA 1851 Inspection

- **Complete Liner Inspection - Required Tests**
 - Water Penetration Barrier Evaluation



NFPA 1851 Cleaning and Decontamination

- **Routine Cleaning**

- Completed by organization's trained personnel
- Hand wash only / no machine washing
- Line dry



NFPA 1851 Cleaning and Decontamination

- **Advanced Cleaning**

- Completed by verified ISP or the organization's trained personnel
- At least every 12 months
- Follow manufacturer's instructions and take care to prevent damage



NFPA 1851 Repair

- **Basic Repair**

- Completed by the manufacturer, verified or unverified ISP or the organization's trained personnel
- Repairs must be made using materials compliant with NFPA 1971
- Limits on repair areas and tasks



NFPA 1851 Repair

- **Advanced Repair**

- Completed by the manufacturer, verified ISP or a verified organization
- “Major” repairs can only be conducted by the manufacturer of verified ISP
- Repairs must be made using materials compliant with NFPA 1971
- Moisture barrier and significant seam repairs



NFPA 1851 Storage

- **Storage Considerations**

- NO SUNLIGHT!
- Clean and dry
- No airtight containers
- Away from sharp objects
- Stored in separate area from living quarters
- Should not be stored in passenger compartment of vehicles
- Prevent contamination

NFPA 1851 Retirement and Disposition

- Shall be retired no more than 10 years from the date of manufacture
- Worn out / cost prohibitive / excessive contamination?
- Retired PPE should be destroyed or may be clearly marked and used for non-live fire training



NFPA 1851 Special Incident Procedure

- **Procedures for handling the custody of PPE that were worn by fire fighters during a serious injury or fatality**
 - Immediate removal from service
 - Chain of custody
 - Identified and stored in paper or cardboard containers
 - Examined by qualified organization members or outside experts
 - Retention time



NFPA 1851 Verification

- Can be obtained by ISPs and organizations
- Only applies to garments and must be conducted by a third party
- Maintain a quality management program
- Verified annually through site visits and testing
- Categories of repair – outer shell, moisture barrier, and thermal barrier



Important Points

- **Understand NFPA 1971 and certification of gear**
- **Understand and utilize NFPA 1851 to obtain the best protection while wearing PPE and the longest safe lifecycle of your PPE**
- **Knowledge is critical to safety**

Quality Partnerships Enhance Worker Safety & Health



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